Networking

INFO/CSE 100, Autumn 2004
Fluency in Information Technology

http://www.cs.washington.edu/100

Networks...

• Computers are useful alone, but are much more useful when connected (networked)
  » Access more information and software than is stored locally
  » Help users to communicate, exchange information … changing ideas about social interaction
  » Perform other services -- printing, audio, video, …
  » Immediate answers:

UW’s networks move more than a trillion bytes per day

Networking Changes Life

• The Internet is making fundamental changes … The FIT text gives 5 ways
  • Nowhere is remote -- access to info is no longer bound to a place
  • Connecting with others -- email is great, but spam?
  • Revised human relationships -- too much time spent online could be bad
  • English becoming a universal language
  • Enhanced freedom of speech, assembly

Readings and References

• Reading
  » Fluency with Information Technology
    • Chapter 3, Making the Connection
Network Structure

- Networks are structured differently based (mostly) on how far apart the computers are
  - Local area network (LAN)
    - a small area such as a room or building
  - Wide area networks (WAN)
    - large area, e.g. distance is more than 1 Km
- What do you think a PAN might be?

Internet: all of the wires, fibers, switches, routers etc. connecting named computers

Local Area Network

- Mac disk and printers available on the nearby Windows PC
- Windows disk and printers available on the nearby Mac

Wide Area Network

- Internet: all of the wires, fibers, switches, routers etc. connecting named computers
- UW servers
- Video conferencing
- World wide web

Protocol Rules!

- To communicate computers need to know how to set-up the info to be sent and interpret the info received
  - Communication rules are a protocol
  - Example protocols
    - Ethernet for physical connection in a LAN
    - TCP/IP -- transmission control protocol / internet protocol -- for Internet
    - HTTP -- hypertext transfer protocol -- for Web
LAN in the Lab

- Ethernet is a popular LAN protocol
  - Recall, it’s a “party line” protocol

![Typical MGH or OUGL Lab](image)

Connection to campus network infrastructure

Ethernet Cable

Campus & The World

- The campus subnetworks interconnect computers of the UW domain which connects to Internet via a gateway
  - the protocol used is TCP/IP

![Network Diagram](image)

IP -- Like Using Postcards

- Information is sent across the Internet using Internet Protocol -- postcard analogy
  - Break message into fixed size units
  - Form IP packets with destination address, sequence number and content
  - Each makes its way separately to destination, possibly taking different routes
  - Reassembled at destination forming message

Taking separate routes lets packets by-pass congestion and out-of-service switches

A Trip to Switzerland

- A packet sent from UW to ETH (Swiss Federal Technical University) took 21 hops
Check Internet Hops

- there are numerous Trace Route utilities
  - Windows: tracert, OSX: Network Utilities, ...

Naming Computers I

- Computers connected to the Internet are part of a network domain
  - a hierarchical scheme that groups computers

  - .edu
  - .washington.edu
  - dante.washington.edu
  - ischool.washington.edu
  - cs.washington.edu
  - june.cs.washington.edu

Naming Computers II

- Computers are named by IP address, four numbers in the range 0-255
  - cse.washington.edu: 128.95.1.4
  - ischool.washington.edu: 128.208.100.150

  - Remembering IP addresses would be brutal for humans, so we use domains
  - Computers find the IP address for a domain name from the Domain Name System
    - an IP address-book computer

Domains

- .edu .com .mil .gov .org .net domains are “top level domains” in the USA
  - Recently, new TLD names added
    - .biz, .info, .name, .pro, .aero, .coop, and .museum
  - Each country has a top level domain name: .ca (Canada), .es (Spain), .de (Germany), .au (Australia), .at (Austria), .us (USA)

The FIT book contains the complete list of country domains
Logical vs Physical

- There are 2 ways to view the Internet
  - Humans see a hierarchy of domains relating computers
    -- logical network
  - Computers see groups of four number IP addresses
    -- physical network
  - Both are ideal for the “users” needs
- The Domain Name System (DNS) relates the logical network to the physical network by translating domains to IP addresses

Client/Server Structure

- The Internet computers rely on the client/server protocol: servers provide services, clients use them
  - Sample servers: email server, web server, ...
  - UW servers: dante, courses, www, student,…
  - Frequently, a “server” is actually many computers acting as one, e.g. dante is a group of more than 50 servers

Protocol: Client packages a request, and sends it to a server; Server does the service and sends a reply

World Wide Web

- World Wide Web is a collection of servers (subset of Internet computers) & the information they give access to using http protocol
  - WWW is not the same as the Internet
  - The “server” is the web site computer and the “client” is the surfer’s browser
  - Many Web server’s domain names begin with www by tradition, but any name is OK
  - Often multiple server names map to the same site: MoMA.org and www.MoMA.org

Client/Server Interaction

- For Web pages, the client requests a page, the server returns it: there’s no permanent connection, just a short conversation
  » details of the conversation are specified by http

![Client/Server Interaction Diagram]
Dissecting a URL

- Web addresses are URLs (uniform resource locator)
  - a server address and a path to a particular file
  - URLs are often redirected to other places
    - http://www.cs.washington.edu/100/

Summary

- Networking is changing the world
  - Internet: named computers using TCP/IP
  - WWW: servers providing access to info

Principles

- Logical network of domain names
- Physical network of IP addresses
- Protocols rule: LAN, TCP/IP, http, ...
- Domain Name System connects the two
- Client/Server, fleeting relationship on WWW